A STUDY OF THE DIGESTIBILITY OF SORGHUM SILAGE AND OAT STRAW

by

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INTRODUCTION

The practice of wintering and grazing beef steers is well adapted to Kansas conditions. Stocker steer calves purchased in the fall and wintered on silage, hay, straw, fodder, dry grass or a combination of these feeds, plus a protein supplement when needed, then grazed a full season, is a system used by many successful cattlemen.

Kansas produces large quantities of roughage in the form of silage, hay and straw, so that this system provides a profitable market for these feeds as well as for the nutritious bluestem and short grass pastures native to this state. Under this system of beef production according to Weber (10), steer calves should be fed to gain three-fourths to one pound per head daily during the winter for most satisfactory results in the combined wintering and grazing period. The performance of cattle fed on various feeds needs much more study so that results can be predicted with greater accuracy. Weber (10) found that the pasture gains of beef cattle tend to be inversely proportional to the gains made the previous winter. This means that the lower gaining steers on winter feed will make larger gains on pasture. However, this is only one of the many factors which influence pasture gains and by no means is it the only one. If the winter feed lot gains are limited to the extent that the steers become unthrifty or unhealthy, subsequent pasture gains might be adversely affected. A deficiency of minerals and vitamins in the

winter feed may have a direct influence on pasture gains.

Atlas Sorgo silage, when full fed and supplemented with cottonseed meal will produce the desired winter gains, McCampbell and Weber (5), Weber (9, 10). Various dry roughages have been fed alone and in combination with silage; however, there appears to be no advantage from feeding dry roughage with silage, Weber (11).

Much straw is available for livestock feed in Kansas as a result of the large amount of small grains produced in this state. However, not enough is known about the composition, digestibility and feeding value of oat straw to justify recommendations concerning its use in a wintering ration.

The experiments reported herein were undertaken with the following objectives: 1. To determine the relative values of Atlas Sorgo silage, oats straw, and a combination of Atlas Sorgo silage and oats straw when supplemented with cottonseed meal; 2. To determine the chemical composition of Atlas Sorgo silage and oat straw; 3. To determine the apparent coefficients of digestibility of Atlas Sorgo silage, oat straw, and a combination of these roughages, when fed with one pound of cottonseed meal.

REVIEW OF LITERATURE

The literature available on this subject is very meager. A large amount of the work on the wintering of beef steers on sorghum silage has been carried out at the Kansas Agricultural

Experiment Station, Manhattan, Kansas.

Gamble (2) in 1906 determined the composition of oat straw and fed it to steers in a nutrition experiment. He did not elaborate on its feeding value, but concluded that oat straw was a poor grade roughage.

Watson, C. J. et al. (8) in 1939 made a comparison of the coefficients of digestibility of oat straw when fed alone and calculated from mixtures with hay and corn silage. Their results are shown in the following data.

Coefficients of digestibility

Ration	Dry matter	Ether extract	Crude fiber	N. F. E.
	per cent			
Oat straw alone	52.1	45.0	57.6	52.0
Calculated from hay ration	52.1	46.6	58.1	51.0
Calculated from silage ration	53.5	38.8	63.4	53.9

The conclusion drawn from this experiment was that there was no associative effects among hay, oat straw and corn silage so far as total digestibility and total digestible nutrients were concerned. Associative digestibility is defined as a change in the digestibility of a feed due to its incorporation in a ration with one or more feeds.

Most of the work with Atlas Sorgo silage for feeding beef steers has been carried out at the Kansas Agricultural Experiment

Station, Manhattan, Kansas.

Bechtel, H. E. et al. (1) determined the chemical composition and apparent digestibility of brown silage from Atlas Sorgo when fed to dairy cows, but the results manifestly are not applicable to the wintering of beef steers.

As early as 1913 (4) investigators used sweet-sorghum silage and cottonseed meal in wintering beef calves in a three-year experiment conducted at the Kansas Agricultural Experiment Station. The beef calves used in these experiments gained an average of 1.12 pounds daily per head.

Silage as a roughage for wintering beef steers has been criticized by some cattlemen because the steers did not gain as much on pasture as steers wintered on dry roughage. Weber (10) states that it is not silage as such but the larger winter gains for which silage is responsible that causes silage-fed cattle to make smaller pasture gains than are made by cattle wintered on dry roughage. When silage is fed in amounts to produce the same winter gains made by cattle fed dry roughage, no significant difference in summer gains may be expected.

Morrison (6) states that the straw from the small grains is high in fiber and supplies less digestible nutrients and much less net energy than good hay. Oat straw with its soft, pliable stems is the most nutritious, followed by barley straw. Wheat straw, being coarse and stiff, is not so readily eaten, and rye straw which is harsh and woody, had better be used for bedding.

EXPERIMENTAL PROCEDURE

The animals used in this experiment were range-bred, Hereford steer calves which graded good. The average initial weight of the steers in the group feeding trial was 411 pounds and of those in the digestion trial, 521 pounds. They were selected for uniformity in size, weight and condition.

The group feeding trial was carried out first in order to determine the value and economy of the rations during a winter feeding period of the length usually recommended.

Three groups of 10 steers each were fed in lots designated I, II, and III, Table 1. The steers in lot I averaged 411 pounds in weight and received a full feed of Atlas Sorgo silage and one pound of cottonseed meal per head per day. The cottonseed meal was fed once a day with the morning feeding of silage. The steers were given all the silage they would consume. It was fed twice a day--morning and evening.

The steers in lot II averaged 411 pounds in weight and were full fed oat straw and one pound of cottonseed meal per head per day. The cottonseed meal was fed once daily, in the morning. The oat straw was kept before the animals at all times, yet there was very little wastage.

The steers in lot III averaged 410 pounds in weight. They were fed a combination of silage and oat straw and one pound of cottonseed meal per head per day. These steers received one-half as much silage as was fed to the steers in lot I and all the oat straw they would consume. The cottonseed meal was fed once a day,

in the morning. Silage was fed morning and evening. The oat straw was kept before the animals at all times. Here again very little roughage was wasted.

The steers were weighed twice when placed on feed, and an average of the weights was taken as the initial weight. After the initial weighing, the steers were weighed every 28 days while on feed. At the close of the feeding trial, the steers were again weighed twice and an average of the two weights was used as the final weight.

The group-feeding phase of the experiment ran from December 5, 1946 to April 24, 1947, a total of 140 days.

The 12 steers used in the digestion trial were put into the nutrition barn in individual stanchions April 16, 1947, and were fed similarly for eight days. The ration was a combination of Atlas Sorgo silage, oat straw and cottonseed meal. This procedure was followed to accustom them to the feeding schedule, the general noise and activity associated with feeding, bedding, and handling necessary to carry out the trial. During this eight-day period it was also possible to determine fairly accurately the amount of feed the steers would eat daily. These 12 steers were divided into three groups of four steers each and designated lots I, II, and III. They were numbered consecutively from one to twelve. Lot I contained steers 1, 2, 3, and 4; lot II, steers 5, 6, 7, and 8; lot III, steers 9, 10, 11, and 12. Emphasis was placed on uniformity among the lots, Table 2.

After the eight-day preliminary period, the steers were put on the experimental ration. The steers in lot I averaged 518

pounds and were full-fed silage and one pound of cottonseed meal per head daily. In lot II, the steers averaged 536 pounds and were full-fed oat straw and one pound of cottonseed meal per head daily. In lot III, the average initial weight was 521 pounds and the steers received half as much silage as was consumed by lot I, all the oat straw they would eat, and one pound of cottonseed meal. All steers were fed morning and evening; one-half pound of cottonseed meal was fed at each feeding.

When the steers were put on the experimental ration an adjustment period of eight days was allowed in order to determine exactly how much each steer would eat daily. As soon as the intake for each steer was established, it was never altered and the same quantity was fed throughout the remainder of the experiment.

The eight-day adjustment period was followed by a ten-day precollection feeding period. It was intended during this period to fill the animals' digestive tracts with the same amount and kind of feed they would receive during the period in which the feces would be collected. Feces were collected for 10 days following this precollection period.

The method of collection used in this experiment was devised by Prof. A. D. Weber, Kansas State College, to overcome the labor shortage during the war years. The method makes use of drop boards which are placed behind each steer to catch the feces voided. The base boards are constructed to measure three feet in width and three feet in length. The front end, which is pushed against the steers' hind feet, has an eight-inch board

which comes up at a vertical angle of 85 degrees to form a lip. The lip board is hinged to the base board and held up by springs so that when a steer lies down his rump will be up on the base board and any feces voided will be caught. At irregular intervals during the day a caretaker scrapes the feces from the front end of the base board to the back. This is done to prevent loss in case the steer should step back onto the board. When these boards are properly adjusted to each steer, there is no significant loss.

Feces collections were made at the same time each day for 10 days. The total amount voided by each steer was collected, weighed, and a representative sample taken. The aliquot was one-thirtieth of the total voided.

A 500-gram sample of silage, a 500-gram sample of oat straw, and a half-pound sample of cottonseed meal, were taken daily for chemical analyses.

DISCUSSION OF RESULTS

Table 1 summarizes the results of the group-feeding trial. The steers in lot I consumed about seven pounds of silage per 100 pounds of live weight. Approximately three pounds of silage were equal to one pound of dry roughage regardless of whether fed alone or in combination. Weber (11) also found this to be the approximate ratio of dry roughage to silage consumed by steers.

The steers in lot I made the largest and most economical gains. The average daily gain per steer was 0.96 pound and the total gain was 135 pounds for the 140 days. The total feed

cost per steer was $15.91.

The steers in lot III gained 0.76 pound per day or a total of 106 pounds as contrasted with 0.36 pound, or a total of 50 pounds per steer in lot II. The total feed cost per steer in lot III was $0.23 more than the total feed cost per steer in lot II. However, the greater gains made in lot III offset this difference in feed cost. The cost per pound gain in lot III was $0.15, whereas the cost per pound gain in lot II was $0.32, or more than twice as much. On the basis of prices used in this experiment, oat straw could not be fed profitably. The total wintering cost was approximately as high as where silage was fed and gains were much smaller; consequently the cost per pound of gain was excessive in lot II, where oat straw was fed as the only roughage.

The steers in lot II finished in rather rough condition but appeared to be strong and thrifty. There was a definite tendency for steers in this lot to develop large, paunchy middles due to the bulkiness, high crude fiber content and low digestibility of the oat straw.

Lots I and III gained the recommended three-fourths to one pound per day and on that basis could be expected to make satisfactory pasture gains. Lot II gained appreciably less than this during the winter; therefore, its combined winter plus pasture gain probably would not be as satisfactory.

Table 2 shows the daily feed consumption per animal in the digestion trial. The steers consumed only about half as much feed per 100 pounds of body weight as the steers in the feed-lot.

This was to be expected as the steers were kept in stanchions all of the time and had no opportunity to exercise and stimulate their appetites. The daily ration was established by offering each steer more than it could possibly ingest from one feeding to the next and weighing back the refused feed. This was done for eight days in order to determine as closely as possible the exact amount each steer would eat daily. After a collection period is started it is essential that steers eat all of the feed offered and not leave any weigh-back, since refused feed must be saved, analysed, and the total nutrients subtracted from the total amount offered. This adds greatly to the chance for error.

The steers in lot III consumed as much dry roughage as the steers in lot II plus half as much silage as the steers in lot I. Oat straw is an unpalatable feed and not readily consumed when fed alone under the confining conditions of a digestion trial. The inclusion of silage in the ration increased its palatability, and the steers consumed more pounds of feed. However, the steers in lot III consumed only 2.30 pounds more of dry matter per day than the steers in lot II and only 3 pounds per day more than the steers in lot I. These are small, yet significant differences. The amount of dry matter eaten by the steers in various lots is reflected in Table 3, which shows the amount of feces voided by each animal.

As shown in Table 1, silage as a roughage caused greater salt consumption. Lot I, with silage as the only roughage, consumed 0.14 pound of salt daily while lot II, receiving oat straw as the

only roughage, consumed only 0.04 pound per day, and lot III receiving a combination of silage and oat straw as roughage consumed 0.08 pound of salt per day. It is generally known that cattle on green feed or silage will consume more salt than cattle on dry roughage. The results obtained in this feed-lot trial are in keeping with this knowledge.

The percentage of dry matter and moisture in the feces are presented in Table 3 only as an interesting sidelight. Many cattlemen believe that cottonseed meal has a costive effect when fed with roughage. The feces from steers 1, 2, 3, and 6 were solid and firm, but no evidence of constipation was noticed either in the feed-lot trial or in the digestion trial.

That the steers in lot II and III drank more water than the steers in lot I is evidenced by the moisture content of the feces. The dryness of the oat straw fed would be expected to increase an animal's thirst. The dry weight of the feces was greater for lot III since these steers were actually ingesting more dry matter, likewise the steers in lot II voided more feces than the animals in lot I due to the larger amount of dry matter consumed.

The steers in lot I ate more pounds of feed than the other animals, but a greater proportion of their ration was moisture. As shown in Table 6, the steers in lot I were able to digest more of the nutrients in the silage, consequently a smaller intake of dry matter provided a larger amount of digestible protein and total digestible nutrients, which is another reason for the lesser dry weight of feces in lot I.

Table 1. Results of feed-lot trial (10 steers per lot). December 5, 1946 to April 24, 1947 (140 days).

	Lot I	Lot II	Lot III
Average daily ration			
Atlas silage, lbs.	27.46	0.00	13.75
Oat straw, lbs.	0.00	9.18	4.81
Cottonseed meal, lbs.	1.00	1.00	1.00
Salt, lbs.	0.14	0.04	0.08
Average initial weight, lbs.	411.00	411.00	410.00
Average final weight, lbs.	546.00	461.00	516.00
Average gain, lbs.	135.00	50.00	106.00
Average daily gain, lbs.	0.96	0.36	0.76
Feed required for 100 pounds gain			
Atlas silage, lbs.	2847.00	0.00	1816.00
Oat straw, lbs.	0.00	2569.00	635.00
Cottonseed meal, lbs.	104.00	280.00	132.00
Salt, lbs.	14.00	12.00	10.00
Cost of feed for 100 pounds gain*	$11.78	$31.87	$15.24
Feed cost per steer*	$15.91	$15.94	$16.17

* Prices for feeds used in this experiment

Cottonseed meal	$90.00 per ton
Oat straw	$15.00 per ton
Silage	$ 5.00 per ton
Corn	$ 1.40 per bu

Table 2. Daily feed consumption per steer in the digestion trial, May 9, 1947 to May 18, 1947 (10 days).

Steer number	Cottonseed meal	Atlas Sorgo silage	Oat straw	Weigh back dry basis
		pounds		
		Lot I		
Steer 1	1	16	0	0
Steer 2	1	16	0	0
Steer 3	1	16	0	0
Steer 4	1	16	0	0
		Lot II		
Steer 5	1	0	6	0
Steer 6	1	0	6	0
Steer 7	1	0	8	0
Steer 8	1	0	6	0
		Lot III		
Steer 9	1	8	6	0
Steer 10	1	8	6	0
Steer 11	1	8	6	7.54
Steer 12	1	8	6	0

Table 3. Total feces voided per animal in the digestion trial, May 9, 1947 to May 18, 1947 (10 days).

Steer number	Wet weight	Dry weight		Dry matter	Moisture
	grams	grams	pounds	per cent	
			Lot I		
Steer 1	42,721	9,360	20.617	21.91	78.09
Steer 2	46,759	10,050	22.136	21.49	78.51
Steer 3	51,061	10,500	23.127	20.56	79.44
Steer 4	52,458	9,810	21.607	18.70	81.30
			Lot II		
Steer 5	82,594	12,030	26.497	14.57	85.43
Steer 6	65,993	13,360	29.427	20.24	79.76
Steer 7	102,181	16,890	37.203	16.53	83.47
Steer 8	79,483	12,030	26.498	15.14	84.86
			Lot III		
Steer 9	104,273	17,910	39.449	17.18	82.82
Steer 10	100,300	17,190	37.863	17.14	82.86
Steer 11	91,320	15,840	34.890	17.35	82.65
Steer 12	117,862	16,980	37.401	14.41	85.89

The composition of feeds is given in Table 4. The nutrients were determined by routine chemical analysis.

The analyses of the feeds were reported on the basis of the moisture naturally present in order to indicate the amount of moisture and dry matter received by each steer as well as the amount of each nutrient consumed. The feces were analysed on a moisture-free basis. The amount of moisture in the feces was not important since the information desired was the exact amount of nutrients excreted. The total amounts of dry matter and moisture voided were calculated and are given in Table 3.

The composition of feces is given in Table 5. The crude protein in the feces from the steers in lot I was noticeably higher than the crude protein in the feces from the steers in either lots II or III, but there was no significant difference in the crude protein content of the feces from the steers in lots II and III. The ether extract content of the feces from the different lots varied but little. The feces from the steers in lot I were lower in crude fiber than in the excreta voided by the animals in lot II and III. This was to be expected, since silage has a much lower crude fiber content than oat straw. The excreta from all steers were fairly uniform in percentage of nitrogen-free extract.

Table 4. Analyses of the feeds (normal basis) used in the group-feeding experiment and in the digestion trial.

Feed	Dry matter	Crude protein	Ether extract	Crude fiber	Moisture	Ash	N F E
				per cent			
Atlas Sorgo silage	28.80	2.51	0.70	8.67	71.20	2.30	14.64
Oat straw	92.14	3.13	1.96	41.69	7.86	7.67	37.70
Cottonseed meal	91.16	39.00	5.56	12.96	8.84	6.37	27.27
Weigh back from steer 11	100.00	7.10	1.75	40.72	0.00	9.26	41.26

Table 5. Composition of feces (dry basis) voided during the ten-day digestion trial, May 9, 1947 to May 18, 1947.

Steer number	Dry matter	Crude protein	Ether extract	Crude fiber	Ash	N F E
			per cent			
1	100.00	13.61	2.35	30.79	12.70	40.54
2	100.00	13.67	2.27	30.88	12.58	40.56
3	100.00	12.95	2.11	30.00	12.67	42.27
4	100.00	13.47	2.24	30.30	.2194	41.05
5	100.00	9.10	2.32	36.34	9.09	43.14
6	100.00	9.38	2.51	36.13	8.52	43.46
7	100.00	8.46	2.19	37.41	9.17	42.76
8	100.00	9.30	2.20	35.95	10.33	41.72
9	100.00	9.10	2.18	36.52	9.72	42.49
10	100.00	9.16	2.43	36.69	9.53	42.18
11	100.00	9.18	2.33	37.45	9.48	41.57
12	100.00	9.05	2.40	36.45	10.91	41.19

The average apparent digestion coefficients are presented in Table 6.

In obtaining the data for intake of nutrients, the feed intake was multiplied by its percentage composition as determined by chemical analysis, Table 4. Similarly, the data for excreted nutrients, Table 5, were calculated and the digested nutrients obtained by subtraction. The final figures, expressed as percentages, are called digestion coefficients.

The use of digestion coefficients in calculating the digestible nutrients in a ration may be illustrated as shown in the following tabulation, using the data given in Tables 1, 4, and 6 for the Atlas Sorgo silage and cottonseed meal fed to lot I in the group-feeding trial:

Nutrients	Total nutrients in 27.46 lbs. of silage and 1 lb. of cottonseed meal	Digestion coefficients	Digestible nutrients
	pounds	per cent	pounds
Crude protein	1.08	62.89	.68
Crude fiber	2.51	56.00	1.40
Nitrogen-free extract	4.29	75.01	3.22
Ether extract	.24	70.98(x2.25)	.38
Total digestible nutrients			5.68

The digestible fat is multiplied by the factor 2.25 because it has that much more energy value than the other nutrients.

The nutritive ratio (NR) as shown in Tables 7 and 8 is the ratio of digestible protein expressed as one, to the sum of digestible carbohydrates and fat, the fat again being multiplied by 2.25. The following formula is used in calculating the second factor of the ratio:

$$\frac{\text{(Digestible fat x 2.25) + digestible NFE + digestible fiber}}{\text{digestible protein}}$$

Using the figures for silage and cottonseed meal as fed in lot I of the feed-lot trial the nutritive ratio is calculated thus:

Digestible ether extract (fat)	0.38
Digestible nitrogen-free extract	3.22
Digestible crude fiber	1.40
Total	5.00
Digestible crude protein	0.68

$$\frac{5.00}{0.68} = 7.35$$

The nutritive ratio is then expressed as 1:7.35. The digestible crude protein, total digestible nutrients and nutritive ratio are shown in Table 7 for the three rations used in the group-feeding trial and are presented in Table 1.

As shown in Table 6, the average apparent digestion coefficients of dry matter, crude protein, ether extract and nitrogen-free extract were higher for silage than for either oat straw or a combination of oat straw and silage. The digestibility of crude fiber in oat straw when fed alone was higher than in either silage or a combination of silage and oat straw; however, the difference was not enough to be of any great importance, and it is in line with coefficients reported by Schneider (7) and Watson et al. (8).

Table 6. Individual and average apparent digestion coefficients obtained in digestion trial conducted from May 9, 1947 to May 18, 1947.

Steer number	Dry matter	Crude protein	Ether extract	Crude fiber	N F E
			per cent		
			Lot I*		
Steer 1	62.64	64.52	71.43	58.11	76.87
Steer 2	59.89	61.74	70.24	54.88	75.13
Steer 3	58.10	62.03	70.83	54.22	72.95
Steer 4	60.85	63.26	71.43	56.79	75.46
Average	60.46	62.89	70.98	56.00	75.10
			Lot II**		
Steer 5	58.85	58.30	64.94	63.38	54.91
Steer 6	54.30	52.25	57.47	59.58	49.55
Steer 7	55.09	50.78	61.50	59.82	51.63
Steer 8	58.85	57.44	66.67	63.76	56.37
Average	56.77	54.69	62.65	61.64	53.12
			Lot III***		
Steer 9	54.88	53.92	62.61	56.65	54.78
Steer 10	56.70	54.46	60.00	58.21	56.91
Steer 11	56.33	55.86	62.67	56.68	57.29
Steer 12	57.23	56.61	60.87	59.00	58.42
Average	56.28	55.21	61.54	57.64	56.85

* Silage and cottonseed meal
** Oat straw and cottonseed meal
***Silage, oat straw and cottonseed meal

Table 7 is included to show a comparison of the rations and nutrients fed in the group-feeding trial. Calculations were made from data obtained in this test and in the digestion trial. The nutritive ratio for silage and cottonseed meal fed in lot I is 1:7.35, which is the nutritive ratio recommended by Morrison (6) and also is the nutritive ratio calculated from the digestible protein and total digestible nutrients recommended by the National Research Council (3), Table 8. The nutritive ratio of 1:12.86 for oat straw and cottonseed meal fed in lot II is extremely wide and doubtless is one of the reasons why the steers did not gain more than they did. The total digestible nutrients were sufficient to have produced larger gains if protein had not been the limiting factor in this ration.

The nutritive ratio of 1:8.18 of the ration fed in lot III is very close to the recommended standard, but the gain was limited by a lack of both digestible protein and total digestible nutrients.

Table 8 presents a comparison of the digestible protein, total digestible nutrients and nutritive ratios of the rations fed in the group-feeding trials with Morrison's recommendations and the National Research Council's (3) recommendations for wintering 400 pound steers to gain three-fourth to one pound daily. The only ration which approached the recommendations was that consisting of silage and cottonseed meal. The ration composed of oat straw and cottonseed meal was low in digestible protein which caused the nutritive ratio to be much wider than that recommended.

Table 7. Comparative nutritive values and digestion coefficients of the rations fed in the feed-lot trial.

Ration	Dry matter	Crude protein	Ether extract	Crude fiber	N F E
			pounds		
Comparative nutritive values					
Lot I					
27.46 lbs. Silage	7.91	0.69	0.19	2.38	4.02
1 lb. Cottonseed meal	0.91	0.39	0.06	0.13	0.27
Total	8.81	1.08	0.24	2.51	4.29
Lot II					
9.18 lbs. Oat straw	8.46	0.29	0.18	3.83	3.46
1 lb. Cottonseed meal	0.91	0.39	0.06	0.13	0.27
Total	9.37	0.68	0.24	3.96	3.73
Lot III					
13.75 lbs. Silage	3.39	0.35	0.10	1.19	2.01
4.81 lbs. Oat straw	4.43	0.15	0.09	2.00	1.18
1 lb. Cottonseed meal	0.91	0.39	0.06	0.13	0.27
Total	9.30	0.89	0.24	3.32	3.09

	Protein	Ether extract	Fiber	N F E	Dig. protein	T D N	Nutritive ratio
	per cent				pounds		1:
Comparative digestion coefficients							
Lot I	62.89	70.98	56.00	75.10	0.68	5.68	7.35
Lot II	54.69	62.65	61.61	53.12	0.37	5.13	12.86
Lot III	55.21	61.54	57.64	56.85	0.49	4.50	8.18

Even though the steers in lot III gained three quarters of a pound, the protein in the ration of oat straw, silage and cottonseed meal was low, hence the nutritive ratio was wider than it should have been for the best results.

Table 8. Recommended feeding standards for wintering 400-pound beef calves to gain 0.75 to 1.00 pound per head daily compared with results obtained in the group-feeding trial.

	Daily gain	Dig. protein daily per animal	T D N daily per animal	Nutritive ratio 1:
	pounds			
Morrison's standard	0.75 to 1.00	0.63 to 0.70	4.80 to 5.70	6.7 to 7.2
N R C standard*	1.00	0.70	6.00	7.57
Lot I	0.96	0.68	5.68	7.35
Lot II	0.36	0.37	5.13	12.86
Lot III	0.76	0.49	4.50	8.18

* Nutrient allowances for beef cattle recommended by National Research Council

SUMMARY AND CONCLUSIONS

Range-bred Hereford steer calves from southwest Texas were purchased and used in a study of the digestibility of sorghum silage and oat straw. They graded good to choice and were uniform both as to quality and weight. Thirty steers were group-fed in three separate lots for 140 days in a feed-lot trial and 12 steers were fed individually in a digestion trial for 30 days. The steers in both trials were fed similar rations of the same kind of feeds. In the digestion trial individual feces collections were made daily for a period of 10 days.

From the data obtained, the following conclusions are justified:

1. Three pounds of silage were equal to one pound of oat straw in satisfying the steers' appetite for roughage.

2. On the basis of prices which prevailed while the experiments were in progress, oat straw could not be fed profitably. The wintering costs per steer fed oat straw were approximately the same as where silage was fed. The gain per steer fed oat straw was very low which made the cost per pound of gain $0.32, an excessive cost. If large quantities of low cost oat straw were on hand, it manifestly could be included in the wintering ration.

3. Silage and one pound of cottonseed meal produced larger gains than oat straw and one pound of cottonseed meal, and larger gains than a combination of silage, oat straw and one pound of cottonseed meal.

4. There was no advantage from adding oat straw to the silage. The gains for steers receiving the combination of oat straw and silage did not equal the gains made by the steers receiving only silage; nor were the gains as economical or the total wintering costs as cheap.

5. The ration of silage and cottonseed meal compared favorably in digestible nutrients and nutritive ratio, with the recommended allowances for 400 pound calves expected to gain three-fourths to one pound daily.

6. The nutrients in silage and cottonseed meal were more digestible than the nutrients in either oat straw and cottonseed meal, or in a combination of silage, oat straw and cottonseed meal.

7. The excreta from steers receiving only oat straw as roughage or oat straw and silage were much more moist than the excreta voided by steers fed silage as the only roughage. No evidence of constipation was observed in either the feed-lot test or the digestion trial.

8. The digestibility of dry matter, crude protein, ether extract and nitrogen-free extract was significantly higher in the ration where silage was fed as the only roughage than in either the ration where oat straw was fed as the only roughage or in the ration where a combination of silage and oat straw were fed as the source of roughage. However, the digestibility of crude fiber was significantly higher in the ration where oat straw was fed as the only source of roughage, than it was in the other rations tested.

9. It appears that there were no associative effects between oat straw and Atlas Sorgo silage so far as total digestibility and total digestible nutrients were concerned.

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